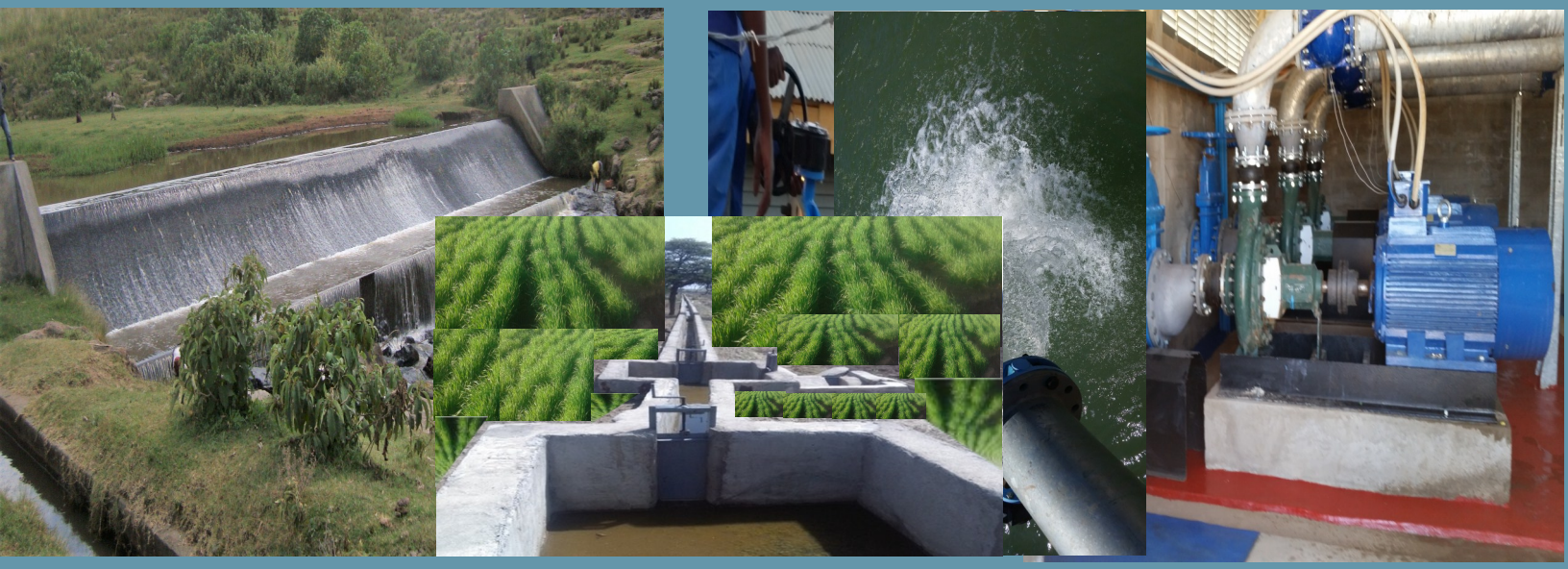
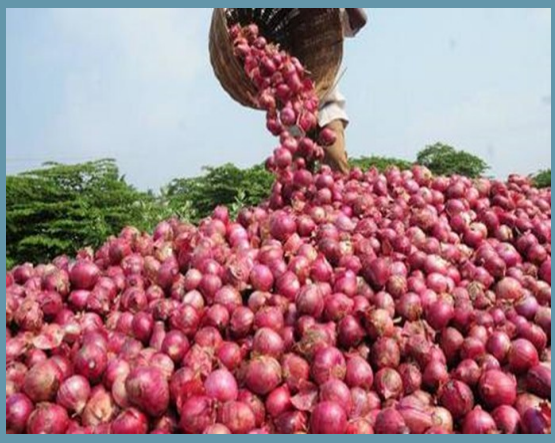
SSIGL 34

NATIONAL GUIDELINES

For Small Scale Irrigation Development in Ethiopia



Quality Assurance and Control for Engineering Sector Study and Design



November 2018

Addis Ababa

MINISTRY OF AGRICULTURE

National Guidelines for Small Scale Irrigation Development in Ethiopia

SSIGL 34: Quality Assurance and Control for Engineering Sector Study and Design

November 2018
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National Guidelines for Small Scale Irrigation Development in Ethiopia

First Edition 2018

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DISCLAIMER

Ministry of Agriculture through the Consultant and core reviewers from all relevant stakeholders included the information to provide the contemporary approach about the subject matter. The information contained in the guidelines is obtained from sources believed tested and reliable and are augmented based on practical experiences. While it is believed that the guideline is enriched with professional advice, for it to be successful, needs services of competent professionals from all respective disciplines. It is believed, the guidelines presented herein are sound and to the expected standard. However, we hereby disclaim any liability, loss or risk taken by individuals, groups, or organization who does not act on the information contained herein as appropriate to the specific SSI site condition.

FORWARD

Ministry of Agriculture, based on the national strategic directions is striving to meet its commitments in which modernizing agriculture is on top of its highest priorities to sustain the rapid, broad-based and fair economic growth and development of the country. To date, major efforts have been made to remodel several important strategies and national guidelines by its major programs and projects.

While efforts have been made to create access to irrigation water and promoting sustainable irrigation development, several barriers are still hindering the implementation process and the performance of the schemes. The major technical constrains starts from poor planning and identification, study, design, construction, operation, and maintenance. One of the main reasons behind this outstanding challenge, in addition to the capacity limitations, is that SSIPs have been studied and designed using many ad-hoc procedures and technical guidelines developed by various local and international institutions.

Despite having several guidelines and manuals developed by different entities such as MoA (IDD)-1986, ESRDF-1997, MoWIE-2002 and JICA/OIDA-2014, still the irrigation professionals follow their own public sources and expertise to fill some important gaps. A number of disparities, constraints and outstanding issues in the study and design procedures, criteria and assumptions have been causing huge variations in all vital aspects of SSI study, design and implementation from region to region and among professionals within the same region and institutions due mainly to the lack of agreed standard technical guidelines. Hence, the SSI Directorate with AGP financial support, led by Generation consultant (GIRDC) and with active involvement of national and regional stakeholders and international development partners, these new and comprehensive national guidelines have been developed.

The SSID guidelines have been developed by addressing all key features in a comprehensive and participatory manner at all levels. The guidelines are believed to be responsive to the prevalent study and design contentious issues; and efforts have been made to make the guidelines simple, flexible and adaptable to almost all regional contexts including concerned partner institution interests. The outlines of the guidelines cover all aspects of irrigation development including project initiation, planning, organizations, site identification and prioritization, feasibility studies and detail designs, contract administration and management, scheme operation, maintenance and management.

Enforceability, standardization, social and environmental safeguard mechanisms are well mainstreamed in the guidelines, hence they shall be used as a guiding framework for engineers and other experts engaged in all SSI development phases. The views and actual procedures of all relevant diverse government bodies, research and higher learning institutions, private companies and development partners has been immensely and thoroughly considered to ensure that all stakeholders are aligned and can work together towards a common goal. Appropriately, the guidelines will be familiarized to the entire stakeholders working in the irrigation development. Besides, significant number of experts in the corresponding subject matter will be effectively trained nationwide; and the guidelines will be tested practically on actual new and developing projects for due consideration of possible improvement. Hence, hereinafter, all involved stakeholders including government & non-governmental organizations, development partners, enterprises, institutions, consultants and individuals in Ethiopia have to adhere to these comprehensive national guidelines in all cases and at all level whilst if any overlooked components are found, it should be documented and communicated to MOA to bring them up-to-date.

Therefore, I congratulate all parties involved in the success of this effort, and urge partners and stakeholders to show a similar level of engagement in the implementation and stick to the guidelines over the coming years.

H.E. Dr. Kaba Urgessa
State Minister, Ministry of Agriculture

SMALL SCALE IRRIGATION DEVELOPMENT VISION

Transforming agricultural production from its dependence on rain-fed practices by creating reliable irrigation system in which smallholder farmers have access to at least one option of water source to increase production and productivity as well as enhance resilience to climate change and thereby ensure food security, maintain increasing income and sustain economic growth.

ACKNOWLEDGEMENTS

The preparation of SSIGLs required extensive inputs from all stakeholders and development partners. Accordingly many professionals from government and development partners have contributed to the realization of the guidelines. To this end MOA would like to extend sincere acknowledgement to all institutions and individuals who have been involved in the review of these SSIGLs for their comprehensive participation, invaluable inputs and encouragement to the completion of the guidelines. There are just too many collaborators involved to name exhaustively and congratulate individually, as many experts from Federal, regional states and development partners have been involved in one way or another in the preparation of the guidelines. The contribution of all of them who actively involved in the development of these SSIGLs is gratefully acknowledged. The Ministry believes that their contributions will be truly appreciated by the users for many years to come.

The Ministry would like to extend its appreciation and gratitude to the following contributors:

- Small-scale and Micro Irrigation Support Project (SMIS) and its team for preparation and financing the publication of SSIGL-31, SSIGL-32, SSIGL- 33 and SSIGL- 34. SMIS also made all efforts and supported to have quality GLs developed as envisioned by the Ministry.
- Agriculture Growth Program (AGP) of the MoA for financing the development and publication of all the guidelines.
- National Agriculture Water Management Platform (NAWMP) for overseeing, guidance and playing key supervisory and quality control roles in the overall preparation process and for the devotion of its members in reviewing and providing invaluable technical inputs to enrich the guidelines.
- Federal Government and Regional States organizations and their staff for their untiring effort in reviewing the guidelines and providing constructive suggestions, recommendations and comments.
- National and international development partners for their unreserved efforts in reviewing the guidelines and providing constructive comments which invaluably improved the quality of the guidelines.

The MOA would also like to extend its high gratitude and sincere thanks to AGP's multi development partners including the International Development Association (IDA)/World Bank, the Canada Department of Foreign Affairs, Trade and Development (DFATD), the United States Agency for International Development (USAID), the Netherlands, the European Commission (EC), the Spanish Agency for International Development (AECID), the Global Agriculture and Food Security Program (GAFSP), the Italy International Development Cooperation, the Food and Agriculture Organization (FAO) and the United Nations Development Program (UNDP).

Moreover, the Ministry would like to express its gratitude to Generation Integrated Rural Development Consultant (GIRDC) and its staff whose determined efforts to the development of these SSIGLs have been invaluable. GIRDC and its team drafted and finalized all the contents of the SSIGLs as per stakeholder suggestions, recommendations and concerns. The MoA recognizes the patience, diligence, tireless, extensive and selfless dedication of the GIRDC and its staff who made this assignment possible.

Finally, we owe courtesy to all national and International source materials cited and referred but unintentionally not cited.

Ministry of Agriculture

DEDICATIONS

The National Guidelines for Small Scale Irrigation Development are dedicated to Ethiopian smallholder farmers, agro-pastoralists, pastoralists, to equip them with appropriate irrigation technology as we envision them empowered and transformed.

LIST OF GUIDELINES

TABLE OF CONTENTS

ACRONYMS

AGP	Agricultural Growth Program
BM	Bench Mark
CAD	Computer Aided Design
GIRDC	Generation Integrated Rural Development Consultant
GIS	Geographic Information System
GPS	Global Positioning System
MOANR	Ministry of Agriculture and Natural Resource
MOWIE	Ministry of Water, Irrigation and Electricity
PDP	Project Delivery Planning
QAQC	Quality Assurance and Quality Control
QCMP	Quality Control Management Plan
SMP	Subject Matter Personnel
SSID	Small Scale Irrigation Development
SSIGL	Small Scale Irrigation Guideline
SSIP	Small Scale Irrigation Project
SSIS	Small Scale Irrigation Scheme
ToR	Terms of Reference

PREFACE

While irrigation development is at the top of the government's priority agendas as it is key to boost production and improve food security as well as to provide inputs for industrial development. Accordingly, irrigated land in different scales has been aggressively expanding from time to time. To this end, to enhance quality delivery of small-scale irrigation development planning, implementation and management, it has been decided to develop standard SSI guidelines that must be nationally applied. In September 2017 the Ministry of Agriculture (MoA) had entrusted Generation Integrated Rural Development Consultant (GIRDC) to prepare the National Small-scale Irrigation Development Guidelines (SSIGLs).

Preparation of the SSIGLs for enhancing development of irrigated agriculture is recognized as one of the many core initiatives of the MoA to improve its delivery system and achieve the targets in irrigated agriculture and fulfill its mission for improving agricultural productivity and production. The core objective of developing SSIGLs is to summarize present thinking, knowledge and practices to enable irrigation practitioners to properly plan, implement and manage community managed SSI schemes to develop the full irrigation potential in a sustainable manner.

As the SSIGLs are prepared based on national and international knowledge, experiences and practices, and describe current and recommended practice and set out the national standard guides and procedures for SSI development, they serve as a source of information and provide guidance. Hence, it is believed that the SSIGLs will contribute to ensuring the quality and timely delivery, operation and maintenance of SSI schemes in the country. The SSIGLs attempt to explain and illustrate the important concepts, considerations and procedures in SSI planning, implementation and management; and shall be used as a guiding framework for professionals engaged in SSI development. Illustrative examples from within the country have been added to enable the users understand the contents, methodologies presented in the SSIGLs.

The intended audiences of the SSIGLs are government organizations, NGOs, CSOs and the private sector involved in SSI development. Professionally, the SSIGLs will be beneficial for experienced and junior planners, experts, contractors, consultants, suppliers, investors, operators and managers of SSI schemes. The SSIGLs will also serve as a useful reference for academia and researchers involved and interested in SSI development. The SSIGLs will guide to ensure that; planning, implementation and management of SSI projects is formalized and set procedures and processes to be followed. As the SSIGLs provide information and guides they must be always fully considered and applied by adapting them to the local specific requirements.

In cognizance with the need for quality SSIGLs, the MoA has duly considered quality assurance and control during preparation of the guidelines. Accordingly, the outlines, contents and scope of the SSIGLs were thoroughly discussed, reviewed and modified by NAWMP members (senior professionals from public, national and international stakeholder) with key stakeholders in many consultative meetings and workshops. Moreover, at each milestone of SSIGL preparation, resource persons from all stakeholders reviewed and confirmed that SSIGLs have met the demands and expectations of users.

Moreover, the Ministry has mobilized resource persons from key Federal, National Regional States level stakeholders and international development partners for review, validation and endorsement of the SSIGLs.

Several hundreds of experienced professionals (who are very qualified experts in their respective fields) from government institutions, relevant private sector and international development partners have significantly contributed to the preparation of the SSIGLs. They have been involved in all aspects of the development of SSIGLs throughout the preparation process. The preparation process included a number of consultation meetings and workshops: (i) workshop to review inception report, (ii) workshop on findings of review of existing guidelines/manuals and proposed contents of the SSIGLs, (iii) meetings to review zero draft SSI GLs, (iv) review workshop on draft SSI GLs, (v) small group review meetings on thematic areas, (vi) small group consultation meetings on its final presentation of contents and layout, (vii) consultation mini-workshops in the National States on semi-final versions of the SSIGLs, and (viii) final write-shop for the appraisal and approval of the final versions of SSIGLs.

The deliberations, concerns, suggestions and comments received from professionals have been duly considered and incorporated by the GIRD Consultant in the final SSIGLs.

There are 34 separate guidelines which are categorized into the following five parts concurrent to SSI development phases:

Part-I. Project Initiation, Planning and Organization Guideline which deals with key considerations and procedures on planning and organization of SSI development projects.

Part-II. Site Identification and Prioritization Guideline which treats physical potential identification and prioritization of investment projects. It presents SSI site selection process and prioritization criteria.

Part-III. Feasibility Study and Detail Design Guidelines for SSID dealing with feasibility study and design concepts, approaches, considerations, requirements and procedures in the study and design of SSI systems.

Part-IV. Contract Administration and Construction Management Guidelines for SSI development presents the considerations, requirements, and procedures involved in construction of works, construction supervision and contract administration.

Part-V. SSI Scheme Management, Operation and Maintenance Guidelines which covers SSI Scheme management and operation.

Moreover, Tools for Small Scale Irrigation development are also prepared as part of SSIGLs.

It is strongly believed and expected that; the SSIGLs will be quickly applied by all stakeholders involved in SSI development and others as appropriate following the dissemination and familiarization process of the guidelines in order to ensure efficient, productive and sustainable irrigation development.

The SSIGLs are envisioned to be updated by incorporating new technologies and experiences including research findings. Therefore, any suggestions, concerns, recommendations and comments on the SSIGLs are highly appreciated and welcome for future updates as per the attached format below. Furthermore, despite efforts in making all types of editorial works, there may still errors, which similarly shall be handled in future undated versions.

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UPDATING AND REVISIONS OF GUIDELINES

The GLs are intended as an up-to-date or a live document enabling revisions, to be updated periodically to incorporate improvements, when and where necessary; may be due to evolving demands, technological changes and changing policies, and regulatory frameworks. Planning, study and design of SSI development interventions is a dynamic process. Advancements in these aspects are necessary to cope up with the changing environment and advancing techniques. Also, based on observation feedbacks and experiences gained during application and implementation of the guidelines, there might be a need to update the requirements, provisions and procedures, as appropriate. Besides, day-by-day, water is becoming more and more valuable. Hence, for efficient water development, utilization and management will have to be designed, planned and constructed with a new set up of mind to keep pace with the changing needs of the time. It may, therefore, be necessary to take up the work of further revision of these GLs.

This current version of the GLs has particular reference to the prevailing conditions in Ethiopia and reflects the experience gained through activities within the sub-sector during subsequent years. This is the first version of the SSI development GLs. This version shall be used as a starting point for future update, revision and improvement. Future updating and revisions to the GLs are anticipated as part of the process of strengthening the standards for planning, study, design, construction, operation and management SSI development in the country.

Completion of the review and updating of the GLs shall be undertaken in close consultation with the federal and regional irrigation institutions and other stakeholders in the irrigation sub-sector including the contracting and consulting industry.

In summary, significant changes to criteria, procedures or any other relevant issues related to technological changes, new policies or revised laws should be incorporated into the GLs from their date of effectiveness. Other minor changes that will not significantly affect the whole nature of the GLs may be accumulated and made periodically. When changes are made and approved, new page(s) incorporating the revision, together with the revision date, will be issued and inserted into the relevant GL section.

All suggestions to improve the GLs should be made in accordance with the following procedures:

I. Users of the GLs must register on the MOA website: Website: www.moa.gov.et
II. Proposed changes should be outlined on the GLs Change Form and forwarded with a covering letter or email of its need and purpose to the Ministry.
III. Agreed changes will be approved by the Ministry on recommendation from the Small-scale Irrigation Directorate and/or other responsible government body.
IV. The release date of the new version will be notified to all registered users and authorities.

Users are kindly requested to present their concerns, suggestions, recommendations and comments for future updates including any omissions and/or obvious errors by completing the following revisions form and submitting it to the Ministry. The Ministry shall appraise such requests for revision and will determine if an update to the guide is justified and necessary; and when such updates will be published. Revisions may take the form of replacement or additional pages. Upon receipt, revision pages are to be incorporated in the GLs and all superseded pages removed.

Suggested Revisions Request Form (Official Letter or Email)

To: ----------
From: ----------
Date: ----------
Description of suggested updates/changes: Include GL code and title, section title and # (heading/subheading #), and page #.

GL Code and Title	Date	Sections/ Heading/Subheading/ Pages/Table/Figure	Explanation	Comments (proposed change)

Note that be specific and include suggested language if possible and include additional sheets for comments, reference materials, charts or graphics.

GLs Change Action

Suggested Change	Recommended Action	Authorized by	Date

Director for SSI Directorate**: _____Date: _____**

The following table helps to track initial issuance of the guidelines and subsequent Updates/Versions and Revisions (Registration of Amendments/Updates).

Revision Register

Version/Issue/Revision No	Reference/Revised Sections/Pages/topics	Description of revision (Comments)	Authorized by	Date

1 SYNOPTIC

According to ISO, Quality (Small Scale Irrigation Development) focuses on the end user current and future needs and strive to exceed customer expectations. In SSI, the farmers are the end user beneficiaries. Beneficiaries to be satisfied the SSI project has to be completed in due time, with acceptable minimum quality standard achieving the intended goal within the contract budget in allowable variance.

Limitations in addressing the above principle results in project delay, unacceptable cost variance, failing in achieving the intended target. When we overlay this to our setting, collecting, organizing, analyzing and interpreting all-encompassing data (socio-economic, community, agronomy, Environment, soil, watershed, engineering geology, hydrology, Engineering, and Topography survey), we fail in quality and quantity meeting the minimum standard which in turn results in delay of projects and unacceptable variation of work in volume, technology and cost. If measures are not taken systematically and institutionalized, the muddle will be deep and sometimes irreversible.

To come out of this quality and quantity delinquent, Quality Control Management Plan (QCMP) that can address all the SSI thematic areas (socio-economic, community, agronomy, Environment, soil, watershed, engineering geology, hydrology, Engineering and Topography survey) data collecting system and process, and analysis and interpretation has to take place. The Quality Assurance and Quality Control (QAQC) are advised to be implemented starting from the planning period and should be mainstreamed in data collection, organization, analysis, interpretation, review and implementation.

In this document, the QAQC is presented in accordance with the the main discipline of the feasibility and the detail design requirement of Small Scale Irrigation Project in Ethiopia. The QAQC is organized from the Terms of Reference of SSI projects prepared for consultants, different guidelines (MOWIE, OIDA-JICA, AGP, IFAD, IDD, NSSI and others) and international experiences.

2 OBJECTIVE

This manual intends the sector to deliver quality service, especially quality infrastructure that serves the beneficiary for the intended purpose to end users for sustainable irrigation development. The main objective of this quality control and assurance manual is to assist the sector to attain at least the minimum acceptable standards of the sector, increase efficiency within the limit of the acceptable budget in the planning, study, design, and Construction.

3 BLUNDERS

Errors and mistakes in human life are unavoidable, but there is an acceptable limit of errors in any business or project. Irrigation project cannot be out of this reality. If errors are out of the acceptable limit it will be a blunder, a serious mistake, embarrassing mistake as a result of carelessness or ignorance that stumbles the project.

To avoid blunders in the SSI development, the QAQC should address the whole system, process, methods of data collection, organization, analyzing, interpreting and communicating. This can instigate from the planning stage of the project, at the planning stage and it has to be embedded in all the process. To comprehend the QAQC establishing minimum standards for all the process and milestones is crucial.

Here below general sources of blunders in SSI are listed:

3.1 STANDARD DATA COLLECTION METHODS

There is a lack of standard data collection tools, where there is respecting the tool is diminutive. Most of the time data are not collected with a structured/ semi structured questionnaire, checklists, and standard formats. Data is collected with individuals level of knowledge, experience, skill, and assumption. In addition to this lack of commitment, especially when data collection is laborious and qualitative plays the major role.

3.2 REQUIRED DATA TYPE UNDERSTANDING

Understanding the data type required for SSI development required by and from each profession is not some time understood by the subject matter personnel (SMP). This emerges from lack of TOR and guideline understandings and lack of experience. In addition to this, some SMPs do not consider or give attention to the impact of their collected data and quality on other disciplines. The degree of the impact of the latter is a series on some disciplines like surveying, hydrology, and Geo-technics.

3.3 UNDERSTANDING OF THE QUANTITY AND REPRESENTATIVE DATA

Shortage of enough amount and representative data is another source of a blunder in SSI development. This is witnessed in many SSI projects data collections; topography survey, land use/cover, beneficiary, geological pits and so on.

3.4 SPECIFIC PROJECT ORIENTED DATA (NON-DESCRIPTIVE DATA)

Most of the time finding and collecting specific project oriented data set is difficult. To compensate such problems wider scale data is collected and interpolated to the specific level that can result in most of the time in a disarray. These types of blunder are mostly seen in the socio - economy, environment, river flow data, rainfall data and the agronomic study.

Most of the topographic data collected do not describe themselves. On the other hand, some data, such as geology and soil pits & others don't describe as their best.

3.5 USE OF UPDATED TECHNOLOGY AS A SOURCE OF DATA & ABUSE

Another source of blunder is lack of use of updated technology. As an example, currently, land use cover can be easily obtained from Google earth pro, Landsat and other satellite imagery sources and interpreting them with remote sensing technology gives a better understanding. It can be a good input for flood for a better design flood estimate. Contrary to this abusing satellite data and using them out of the scope are another source of blunder, such as using SRTM or ASTER data for detail design.

3.6 KEY EXPERTS INVOLVEMENT

Most of the time one expert is assigned to handle more than one thematic study, for example an engineer may be asked to conduct geological investigation, hydrology analysis sometimes was undertaken by non- hydrologists . Substituting one thematic expert by other thematic expert, in most of the case, had created knowledge and skill gap.

3.7 DATA ANALYSIS AND INTERPRETATION SKILL

In most cases, knowledge is not the significant problem facing SSI development, but the ability to materialize the knowledge to practice is the source of blunder. Especially young professionals having the required knowledge, but not the skill for sound data collection and analysis contribute to a significant error. Moreover, interpreting the result to the real world is another source of blunder.

3.8 STANDARDIZED COMMUNICATION/ STUDY DOCUMENTS, DRAWINGS, SPECIFICATIONS AND BILL OF QUANTITIES /

After all data collection, organization, analysis, and interpretations are finalized, proper and standard communication is critical. In SSI development to realize the project, study and design document and drawings are inevitable. But this is another point of a blunder; drawings most of the time are not clear, layers are undefined, hatches confused, specifications are jumbled, items are missed from the design or drawings, units misrepresented or missed, quantities under/overestimated and items will be forgotten.

3.9 AMALGAMATION AND SYNCHRONIZATION

SSI development is like a symphony, complex musical composition lead by a conductor. SSI development is a mix of social, cultural, economic, environment, earth science, engineering, agriculture and other ingredients. Luck of harmonization & synchronization among these thematic is another loophole resulting blunder.

3.10 REFUTING OUTSTANDING GUIDELINES

Currently, there are a number of Irrigation study guidelines in the country; MOWIE, OIDA-JICA, IDD, and others. Respecting these guidelines and working accordingly is a gap. Recently, the MoALR prepared a National Guideline for SSI.

3.11 PROPER PLANNING SEASON

Consultants, experts and others complain on the schedule of irrigation study and design season planning. Most of the time the assignment were given in rain season or where there is rain fed

crop and in unfavorable time. This results, in collection of non- reliable data that leads to wrong analysis and interpretation.

3.12 ALLOCATING SUFFICIENT TIME

In connection with the above point, most clients and consultants don't allocate sufficient data collection and office time.

3.13 GENUINE (EMPOWERED) COMMUNITY PARTICIPATION AND CONSULTATION

Most of the SSI projects studied and designed were lucking genuine stakeholder participation. The so-called participation was limited to discussion of willingness and petition collection. Empowered stakeholders participation includes involves beneficiaries in study and design alternative selection, review, ground truth and even in decision making in all disciplines.

4 QUALITY CONTROL MANAGEMENT (QCM)

Quality is not merely an outcome, but also the result of a process. A comprehensive Quality Program is an all-encompassing approach to study and design that includes the beneficiary, Client, consultant, and specifically the design team. Each entity is responsible for the quality of the deliverables and activities performed. An effective quality program includes; a Quality Control (QC) program- covering all project activities, acceptance of the QC procedures, if it exists, measuring and reporting QC findings using qualified personnel, independent assurance of the quality procedures and metrics, review and analysis of the results, and a rectifying procedure. In short, an effective quality program is a joint effort of the entire project team toward achieving a common goal a quality project.

Currently, Introducing Quality Assurance and Quality Control (QAQC) in SSI development is inexorable. This needs a system, institutional setup, established minimum standard to be respected. In the existing situation of Irrigation sectors in Ethiopia, these are not in place. To alleviate the challenging problem, introducing and establishing ad hoc QCM is an option. This to improve the quality and quantity delinquent.

5 QAQC PRINCIPLES

QAQC of any SSI study and design should not be based on reject or accept of results, rather it should be based on the management of the data collection equipment, method, analysis, interpretation, and presentation. In general, it should be based on the managing process. This saves time and money and meets the client expectations. In order to assure the intended result.

6 QUALITY ASSURANCE MEASURES FOR SSI

Unless specific plan is required by the client, a minimum the following should be considered as appropriate quality assurance measures:

1. Project Delivery Planning (PDP)
2. The use of Qualified Staff, equipment, and tools
3. Adherence to standards
4. Clear articulated Specific, Measurable, Achievable, Result in focused and Time bound assignment
5. Data tracking and Documentations

6.1 PROJECT DELIVERY PLANNING (PDP)

Quality assurance of SSI development work should begin with Project Delivery Planning. The Project Delivery Plan should include and address the following:

- A Detailed Statement of Work and Scope of Required Services
- Schedules, Budgets, Deliverables and Milestone Points
- Allocating enough time in the right season
- Precise Definition of Required Deliverables with unit of measurement,
- Contract Standards, Client Imposed Standards (TOR), and/or Industry Standards To be Used
- The Use of Advanced Technology (equipment and analysis tools)
- Tasks and Responsibilities
- Types, forms and number of reporting documents that Will be required
- Statements of Safety Procedures for field and office work
- Review Modality, Process and Checking Forms

6.2 THE USE OF QUALIFIED STAFF, EQUIPMENT, AND TOOLS

In QA/QC quality of personnel, equipment and tools play a substantial role. Personnel knowledge, skill, and experience contribute to the QA of the Study and Design. Personnel should have sound knowledge, technical excellence, and experience on their assignment, equipment, and tools to be used, and should be familiar with the assignment.

The equipment and tools to be used in the assignment should conform to the known and acceptable standards. The client should approve the equipment and tools before any use, the consultant should ask acceptance from the client or should give training to the client before new equipment and tools are introduced

6.3 ADHERENCE TO STANDARDS

Three types of established standards should be considered for each project:

- Industry or discipline standards,
- Client-imposed standards, and
- Company/ Consultant/ firm's standards.

Industry standards in this case mean, common and known standards in SSI development in Ethiopia or other similar country like the FEDIC, Ethiopian Construction Codes and Standards, Ethiopian Road Authority manuals and specification, and other general industry principle. It may be considered the minimum level of standards for a given project. These disciplines are the

common standards used throughout the industry or discipline and are generally based on liability and protection of the public.

Client standards are those unique standards set by the project owner. Management of these elements and ensuring their compliance with the work plan, standards, schedule, budget and high quality results will be the major task of the client/project manager. This can be done by;

1. Providing a complete project briefing prior to commencement of any work. The briefing should include all staff and subcontractors assigned to the tasks of the project.
2. Provide all team members or consultants/ Contractors with a written work plan, including a description of tasks, schedule, budget and specifications for the work involved.
3. Arrange the modality of report and
4. Manage all milestone events on an individual basis.

Company/ Consultant/ firm's standards are in house standards formulated for quality assurance.

6.4 CLEAR ARTICULATED SMART ASSIGNMENT

The QAQC should articulate the works in specific, measurable, achievable, result and time bound assignment. This includes making sure that the consultant/contractor can have a clear understanding of the latest scope of work and contract conditions, what equipment are required and resources to perform quality work. Clearly, indicate how to manage all milestone events on an individual basis.

6.5 TRACKING AND DOCUMENTATION

The collected primary and secondary data should be traceable by the client or quality assurance experts. To do this, source of data, data provider institution/ individual, time, and data type (qualitative/quantitative/ phots/others) should be clearly presented in the document. When it is primary data, how it is collected, when, where, personnel involved, what tools employed, the degree of error, number of data collected and other related issues should be clearly stated for the sake of traceability.

7 PROJECT PROFILE AND COMPLETENESS

7.1 SALIENT FEATURE OF THE PROJECT

No	Description	
1	Name of the SSI Project	
2	Region	
3	Zone	
4	District / Woreda	
5	Kebele / specific area	
6	Head Work Grid Location (East, North)	_____, _____
7	River center elevation	
8	Command area peak coordinate & elevation (East, North)	_____, _____
9	Command area (ha)	

7.2 AVAILABILITY OF THE FEASIBILITY STUDY AND DETAIL DESIGN COMPLETENESS (YES/NO)

NO	Type of study/survey	Existing Document	Remark (Signed / stamped)
1	Socio Economic Study Report		
2	Community Study Report		
3	Surveying / Topography study Report		
4	Hydro-metrology Study Report		
5	Engineering Geology / Geo Technic report		
6	Irrigation Engineering Report (Head work)		
7	Irrigation System Layout & Structure Report		
8	Irrigation Agronomy Report		
9	Soil Survey & Investigation Report		
10	Watershed Management Study Report		
11	Environmental (Impact) Assessment Report		
12	Take off the sheet and the Bill of Quantity		
13	Financial Analysis		
14	Drawing set (Numbers)		

*All these procedures should be checked whether they are done according to PIDM

8 PLANNING & DESIGN PROCESS (YES/NO)

No	Review Topic	Existing Document	Review Result/Comment (Against AGP /TOR/OIDA-JICA/ MOWIE/ guidelines)
1	Written request/petition for assistance by farmers or their representatives for the development		
2	Community sensitization campaign undertaken & farmers' understanding of the project		
3	List of Fe/male beneficiaries attached		
4	Formation of Irrigation Design Committee (IDC) / IWUA completed (at the committee level)		
5	Training / Awareness of IDC/IWUC leaders and members conducted		
6	Project Preparation & Implementation MOU signed among stakeholders, including IWU Committee		
7	Design review workshops/forum conducted		
8	Cost sharing & Detailed Design Evaluation Meeting with beneficiaries conducted / Consultation with beneficiaries & other stakeholders		
9	Beneficiary contribution clearly determined and Cost sharing arrangements agreed with them & signed		
10	Final Project Plan prepared & approved by all stakeholders (BOWR, BOA, CPA, Woreda Administration, Woreda Agriculture Office, IWUC) and endorsed by IWUA general assembly		
11	IWUA institutional development plan prepared		
12	Irrigation Infrastructure development plan prepared		
13	Water Allocation and Delivery Service plan prepared		
14	Agriculture development and support service plan prepared		
15	Marketing development plan prepared		
16	Environmental management plan prepared		
17	Watershed development and management plan prepared		
18	O&M Plan/manual prepared		
	Registration of land use rights in (envisaged) command area completed		
19	Land use system & land size identified		
20	Marketing Assessment conducted		
21	Access to market identified (urban consumers)		
22	Availability of agricultural inputs supply markets		
23	Availability of basic social services (schools, Health, extension etc)		
24	Availability of agricultural supporting services (like micro credit)		

9 HYDRO-METEOROLOGICAL STUDY REVIEW

9.1 DATA COLLECTION TOOLS

List the data collection tool used for the project and explain the status, the model, the allowable error and other quality related parameters in table.

9.1.1 Data collection equipment / tool quality checklist

S. No	Equipment /tool	Description of the equipment	Status (New/ medium/ Old)	Model/ Version (year)	Functionality (Yes/No)	Manufacturer allowable error	Seasonal service /maintenance (yes/No– when)	Remark
Data Collection tool and Source								
1	GPS							
2	Current meter							
3	Parshall Flume							
4	Weir/ Notch							
5	Volumetric material							
6	Measuring tape							
7	Stop watch							
8	Floating material							
9	Topography map (hard copy)							
10	Topography map (digital)							
11	DEM (resolution)							
12	Other digital materials							
13	plan meter							

Note: 1. Some of the response can be NA-not applicable

2. Floating material has to be non-absorbent and a material which stick to the flow surface.

9.1.2 Analysis tool quality checklist

S. No	Analysis tool	Yes/No (compare with the TOR)	Remark
1	Arc GIS		
2	Arc Hydro		
3	SWAT		
4	HEC- Family		
5	WEAP		

9.1.3 Hydro-metrology data, analysis and report quality check

No	Review Topic	Existing Document	Minimum Bench mark from MOWIE, OIDA-JICA, IDD & SSI GL / Others
Catchment/ River Morphology			
1	Basin/Sub basin / description		Main & sub catchment Description
2	Geomorphology of the catchment & stream		Shape, size, slope and length, roughness (river bed and bank) of the main stream, formation, relative depth, narrow/flat, etc & influence
3	Catchment characteristics		Land use, land cover – Area (ha) & percent of coverage
4	Soil and geological condition of the catchment		Soil type & hydrological group,
5	Sediment study (at least from secondary data)		Indicative (Reference)
Hydro- metrological data source , quality & analysis			
6	Source of climate & river flow data		Station, distance, altitude, recent, rational for selection
7	Number of Stations considered		For headwork and command
8	Representation of the selected stations		Distance, altitude
9	Optimal number of stations (if applicable)		allowable percentage of error <20%
10	River & Climatic data availability (years) - temperature, rainfall, humidity, wind speed and sunshine hours, evaportaion		Data Type, No years (>20 Yrs)
11	Data quality		Screening, trend or discontinuity, reliability, adequacy & consistency - Outliers, % missed data
12	Missed data estimating and filling, especially rainfall & river data		Methods expected- Arithmetic mean – when CV <10%, Thiessen polygon, Isohyetal, Normal ratio (if no orographic variation), correlation method, Rainfall-runoff, absolute value of correlation, /R/≥ 0.8 , mass curve
13	Average Areal rainfall		Methods expected- Arithmetic, Thiessen polygon, Isohyetal,
14	Design rainfall estimation (mm, criteria, method)		
Hydrology of the Water Source, Demand and Water Availability			
15	Existing abstractions & predicted future demands upstream and downstream of proposed abstraction site (Why & when as much as possible) (litres per second)		Inventory of demand & allocation per month
16	Critical Month in water balance/budget		Peak demand month & amount
17	Monthly flow availability (availability Vs allowable)		Gauge station, no of years, minimum, mean, maximum
18	Mean annual discharge (l/s, criteria, method of computation)		
19	Low flow/Base flow & method of measurement		When, No of measurements, verification, comparison of measured flow with gauge & other analysis, low flow curve & indices (Q_{95}, and others), float location,

No	Review Topic	Existing Document	Minimum Bench mark from MOWIE, OIDA-JICA, IDD & SSI GL / Others
20	Recommended scheme design flow -		either base flow minus d/s demand & environmental flow (if sufficient flow is available), or dependable flow i.e. 80% of mean monthly flow for storage
21	Eco System service release		
22	Design Flood Analysis for gauged catchment (criteria, method of estimation)		Flood frequency method, Gumbel's method, log-normal method, Pearson type III or Vent Cho method, other empirical – decision rational among the results obtained
23	Design Flood Analysis for ungauged catchment (criteria, method of estimation)		Rational method, Empirical methods, envelope curves, SCS, flood mark & flood levels, Regional flood frequency, Catchment transfer from nearby similar characteristics catchment gauge. At least 3 methods has to be used
24	Design flood effects on the hydrological regime (especially on flood plain)		Inundated area – farm or residence, map of inundation area, elevation
25	Return period for design flood (years)		Field drain-5, side ditches & pipe culverts-10, culvert <2 & <6m span-25, >6 -<15- 50, weir 50 years, Dam -100 years.
26	New zero elevation		
27	Reservoir simulation		
28	Design flood		One recommended value
29	Net possible/ allowable flow to be abstracted (litres per second)		One recommended value

9.2 ENGINEERING SURVEYING

9.2.1 Surveying data collection tool quality check list

S. No	Equipment tool	Description of the equipment	Status (New/medium/ Old)	Model /version (year)	Function (Yes/No)	Manufacturer allowable error	Seasonal service /maintenance (yes/No – when)	Remark
Data Collection tool								
1	GPS							
2	Engineering Level (set)							
3	Total Station (set)							
4	Compass							
5	Measuring Tape							
6	Range pole							

9.2.2 Analysis tool quality checklist

S. No	Analysis tool	Yes/ No (compare with TOR)	Remark
1	Eagle point		
2	AutoCAD Civil 3D		
3	Terra Model		
4	Arc GIS		
5	Global Mapper		
6	Surfer		

9.2.3 Engineering surveying data, analysis and report quality check

NO	Key Point of review	Existing in the document against The BM	Minimum Bench mark (TOR/ MOA GL/ JICA-OIDA GL/ IDD or other related docs
1	BM (general)		BMs should be cast in concrete with dimensions of at least 30 cm x 30 cm x 60 cm (length x width x depth)
2	Head work BM		4 –two in each side
3	First BM Value		GPS value, Adindan Zone 36/37/38, UTM - explanation
4	Conveyance & Command area BM		1BM /10 ha or sufficient BM based on topography, permanent/fixed
5	Headwork topo data		All natural & artificial feature at head work, river banks break lines minimum 200m U/S & D/S from the proposed weir axis, flood Mark, Geological Pits.
6	Headwork topo plot		Data collected & Plotted Scale1:500, 0.5m contour minimum 40 m radius in both direction, every feature & test pits plotted. Annotation-center, spacing max 300m,
7	Head work cross section		Plotted in Scale 1:100 V, 1:1000 H, maximum 3m chainage. Extend beyond the flood mark both side.
8	Longitudinal Profile of the stream around the Headwork site		Data collected & plotted min 200m U/S & D/S from the weir axis, Scale 1:100 for V & 1:1000 H or equivalent magnification
9	Proposed Main canal profile chainage		20- 30 m chainage interval, plotted 1:1000 H, 1:100 V
			Strip topo data collected 10/20m both side from center, plotted 1:1000 scale, 0.5m contour, geological pit
10	Command area		Major features (gully, traditional canals, electric lines, settlements, footpath, cattle crossings, big trees, symmetries etc.)
11			Plotted Scale1:1000, 1.0m minor & 5 m major contour interval unless it is very flat (0.25-0.5 min 1.5-2.5 index contour)
12			Geological pit locations
13			Soil pit location
14	Structures survey – Aqueducts, cross drainages, road crossings		Detail survey (cross-section and longitudinal profile) for gullies, streams, crossing, marshy areas, etc. u/s & D/S strip topo
15	Night storage		Detail topo & location

NO	Key Point of review	Existing in the document against The BM	Minimum Bench mark (TOR/ MOA GL/ JICA-OIDA GL/ IDD or other related docs
16	Main road cross		
17	Dam		Topo (300 m U/S and D/S), longitudinal profile, cross section including dam axis
18	Reservoir area		Topo, longitudinal profile, x-section, 5m plus on max. flood level survey

9.3 HYDRAULIC & STRUCTURAL DESIGN WORKS

9.3.1 Analysis tool quality checklist

S. No	Analysis tool	Description of the equipment	Version (year/ trial/student/free/full)
1	Eagle point		
2	AutoCAD Civil 3D		
3	AutoCAD		
4	Arc GIS		
5	Global Mapper		
6	GeoStudio		
7	WaterCAD		
8	WaterGEM		

9.3.2 Hydraulic & structural design and report quality check

9.3.2.1 Diversion head work

No	Review Topic	Existing Document	Review Result/Comment (Against accepted guidelines)
	Diversion Weir (Head work)		
General description of site investigation			
1	Head work Location		Narratives, Region, Zone, District, Kebele, Specific area, Coordinate
2	Head Work site selection		At least 3 candidates and , Selection criteria satisfaction
3	Review of the Headwork topography; clarity & ground representation		BMs, Surveying data and all features, weir axis
4	Headwork Geology review		River bank & bed, Foundation material
5	Availability of construction materials in quantity, type & quality		Review & determine weir /dam material
6	Maximum elevation of the command area/ first turnout level		OGL/Bed level of the first turnout
7	Review of flood mark & inundation		Flood mark of both sides (maximum elevation of the two side)
Diversion Headwork design input data organization			
8	Design flood data from hydrology report		Taken from (Harmonized with) hydrology analysis
9	Low/design canal flow		Taken from (Harmonized with) hydrology analysis

No	Review Topic	Existing Document	Review Result/Comment (Against accepted guidelines)
10	Flood plain		Inundated area from hydrology & Headwork topo
11	River cross section & longitudinal profile		Lower & upper river edge, river center, max 3m Chainage interval in rivers course, max 5m chainage interval outside the stream, Max flood mark, at least Two BM on the axis.
12	Longitudinal profile		Minimum 100m U/S & D/S from the axis, significant slope change, plot 1:100 V-1:1000 H
13	Rating Curve		Flood height, flood amount
14	Foundation depth		Decided based geology report - harmonization
15	Foundation material carrying capacity		Geology report harmonization
16	River bank & training		Geology report harmonization
17	Weir material specific gravity		Geology report harmonization
Diversion Headwork Detail Design			
18	River bed level		River center / harmonized with surveying
19	Intake level determination		First offtake level or peak command, distance b/n intake & first offtake, sound slope, loses
20	Weir crest level determination		Sill height, water depth in canal, intake level consideration, loses
21	U/S Energy profile, water level		Sketch with levels
22	D/s Energy Profile , water level		Sketch with levels
23	Backwater effect		Inundation & protection
24	Weir length		Natural river bank span (bank to bank), river training
25	Wing wall height		Free board, water level
26	Weir top width		
	Stilling basin		
27	Floor thickness		Dynamic & static case
28	Percolation length		U/s & D/s cutoff depth, u/s & D/s apron length, creep coffeicent
29	Exit gradient		Exit gradient Vs soil type
30	aprons		Length & thickness determination
31	Weir part detail determination		Bligh's (bottom width, Top width)
32	Safety against overturning		Standard (dynamic & static)
29	Safety against sliding		Standard (dynamic & static)
30	Safety against tension		Standard (dynamic & static)
31	Intake structures (type and design)		Hydraulics, Size, material specification
32	Under Sluice structure (Type and design)		Hydraulics, Size, material specification
33	Basin length		
34	End seal height		
35	Other dissipation methods / baffle/		
	Protection works and Cut-off		
36	Computed score depth		
37	Depths of u/s and d/s piles		
38	Protection works		

No	Review Topic	Existing Document	Review Result/Comment (Against accepted guidelines)
39	Stone riprap (u/s & d/s)		
40	Gabion works (u/s & d/s)		
	Design of regulating and control structures		
41	Turnout		Hydraulics & dimension
42	Division box		Hydraulics & dimension
43	Drop		Hydraulics & dimension
44	Road culvert		Hydraulics, structure & dimension
45	Aqueduct/ Flumes		Hydraulics, structure & dimension
46	Chute		Hydraulics, energy dissipater, structure & dimension
	Cross drainage works		
47	Level crossing		Hydraulics & dimension
48	Drainage culvert		Hydraulics & dimension
49	Supper passage		Hydraulics & dimension
	Farm Roads		
50	Length & width		
51	Cut/ fill volume		
52	crossings		

9.3.2.2 Small embankment dam

No	Review Topic	Existing Document	Review Result/Comment (Against SSI NGL)
Embankment Dam			
General description of site investigation			
1	Head work Location		Na Narratives, Region, Zone, District, Kebele, Specific area, Coordinate
2	Head Work site selection		Selection with alternative option
3	Review of the Headwork topography; clarity & ground representation		BMs, Surveying data and all features, dam axis, reservoir, outlet, spillway
4	Headwork Geology review		River bed, Abutment, Foundation, reservoir, outlet, spillway
5	Availability of construction materials		Review & determining dam material in quantity, type & quality, borrow area location
6	Maximum elevation of the command area/ first turnout level		OGL/Bed level of the first turnout (command peak)
7	Tail water level		Consideration in spill way exit structure
Dam body design input data organization			
8	Head work topo		Harmonized with surveying report
9	Foundation condition		Harmonized with geology and Geotechnical report , foundation material, permeability, soundness, level of rock/impervious material
10	Construction material		Harmonized with geology and Geotechnical report Type, quantity, engineering properties
11	Seismic condition , fault		Harmonized with geology and Geotechnical report, seismic coefficient (v &H)
12	Wave run-up		Wind speed ,fetch length
13	Top width size		Purpose (access, inspection, stability), minimum requirements

No	Review Topic	Existing Document	Review Result/Comment (Against SSI NGL)
Spillway design input data organization			
14	Design flood data		Harmonized from Hydrology report , routed
15	Location and alignment		Topography, geology, downstream risk
16	Type and shape		Justification
17	purpose		Dam safety, flood discharge
Outlet (irrigation) design input data organization			
18	Outlet level (sill)		Peak Command area level, Dead storage,
19	Alignment, location , Size		Geology, command level/ area, irrigation duty, topography
20	Flow control		Justification (u/s or d/s)
21	Sediment		u/s control, dead storage allocation
Reservoir design input data organization			
22	Reservoir topo		Harmonized with surveying report
23	Reservoir condition		Water tightness, size, shape, rim stability, slope, saddle
24	Catchment yield		Harmonized with Hydrology report
25	Sediment load		Harmonized with Hydrology report
26	Command area		Size, irrigation duty
27	Climatic data		Evaporation
Reservoir Design			
28	New zero elevation fixation (Dead storage)		Sediment distribution analysis, fixing level, useful reservoir life
29	Reservoir simulation/ operation study		Dead storage level/volume, irrigation demand, other uses losses (evaporation, seepage, etc)
30	Fixing normal pool level (NPL)		Reservoir operation study , Reservoir sizing, reservoir-area-elevation curve, judgment
Spillway design			
31	Approach channel / Entrance channel		Spillway location and type , hydraulic design
32	Control structure		Routed flood, control structure type, size (height and crest),coefficient of discharge, overflow depth, stability analysis, hydraulic and structural design
33	Discharge channel / conveyance features / waterways		Alignment, flow condition, capacity, size, lining, hydraulic and structural design
34	Terminal Structures / Energy Dissipaters		Incoming velocity, fraude number, decision on energy dissipater type, sizing and arrangement.
35	Exit channels		Safe exit , cut-off, river bed level,
Dam body detail design			
36	Foundation		Water tightness, bearing capacity, volume, impervious/ rock level, cut-off wall depth, general foundation
37	Free board		NPL, Spill way surcharge, wave run up, settlement allowance, seismic allowance,
38	Fixing dam height		NPL, Free board, allowances
39	Dam section		Construction material, technology, Decision on the section (homogenous /core / zoned)

No	Review Topic	Existing Document	Review Result/Comment (Against SSI NGL)
40	Top width		Minimum standard, access requirements, earth quake, working space
41	Seepage analysis		At NPL, and for u/s different water level condition, using Geostudio
42	Dam body stability		Shear strength parameters (C, and Ø) Unit weight (Bulk unit weight, saturated unit weight and submerged unit weight) Top level of the dam, MWL, NPL, LWL Using Geostudio
	During/End of construction		FS>1.3
	Sudden drawdown, U/S slope		FS> 1.3
	Steady state seepage, D/S slope		FS >1.5
	Earth quake , u/s and d/s		FS> 1.1
41	Filter		Material, arrangement, Thickness , location
42	Rock toe		Height, top width, side slope
43	Toe drain		Location and size
44	Slope protection		u/s and d/s face of dam, drain
45	Berm		Location , interval , width, slope
Outlet detail design			
46	capacity		Irrigation water demand, downstream needs, flood control regulation, storage considerations, power generation needs (where the outlet works is used as penstock for small power-plants)
47	Inlet		Dead storage level, u/s or d/s control, intake tower
48	Conveyance		Surcharge load, water pressure, pipe material, pipe cover, irrigation demand
49	Terminal structure		Selection of energy dissipater and its hydraulic and structural design, MWL
50	Flow Controls		u/s or d/s , type
Coffer dam			
51	Design and location		Sound justification
Dam Instrumentation			
52	Provision		Standard for small dam safety

9.4 CONVEYANCE/ CANAL SYSTEM

No	Description	Project Doc	TOR, Guideline BM
	Conveyance /Main Canal		
1	Main Canal		contour, visible & clear, heavy line weight
2	Design discharge determination		Duty and command area
3	Total length		
4	Proposed canal Profile data acceptance/ modification		Adjustments, best fittings
5	Geological study result harmonization with canal design		Consideration in design
6	Canal shapes decision criteria		Soil, hydraulic reasons
7	Canal Slope determination		Soil, topography
8	Permissible velocity		Soil type, lining type
9	Lined and earthen canal location identified		Length, canal sections with chainage
10	Berm consideration based on canal depth & bank stability		Side slope, soil type
11	Slab or other technology consideration in deep cut canal		Depth difference b/n OGL & Canal
12	Fill canal (Fill + Compaction)		Phreatic line, type of soil
	Economic section design		b/d ratio, sufficient free board, side slopes, proper manning coefficient
	Secondary Canals		
13	Secondary Canal		ASMP ridge, visible & clear, heavy line weight
14	Design discharge determination		Duty and command area
15	Total length		
16	Canal Profile data acceptance/ modification		best fittings, minimum drop
17	Geological study result harmonization with canal design		Consideration in design
18	Canal shapes decision criteria		Soil, hydraulic reasons
19	Canal Slope determination		Soil, topography
20	Permissible velocity		Soil type, lining type
21	Lined and earthen canal location identified		Length, canal sections with chainage
22	Berm consideration based on canal depth & bank stability		Side slope, soil type
23	Slab or other technology consideration in deep cut canal		Depth difference b/n OGL & Canal
24	Fill canal (Fill + Compaction)		Phreatic line, type of soil
25	Economic section design		b/d ratio, sufficient free board, side slopes, proper manning coefficient
	Tertiary Canal		
26	Tertiary Canal		ASMP contour intended, visible & clear, heavy line weight
27	Design discharge determination		Duty and command area
28	Total length		

No	Description	Project Doc	TOR, Guideline BM
29	Proposed canal Profile data acceptance/ modification		Adjustments, best fittings
30	Geological study result harmonization with canal design		Consideration in design
31	Canal shapes decision criteria		Soil, hydraulic reasons
32	Canal Slope determination		Soil, topography
33	Permissible velocity		Soil type, lining type
34	Lined and earthen canal location identified		Length, canal sections with chainage
35	Berm consideration based on canal depth & bank stability		Side slope, soil type
36	Slab or other technology consideration in deep cut canal		Depth difference b/n OGL & Canal
37	Fill canal (Fill + Compaction)		Phreatic line, type of soil
	Economic section design		b/d ratio, sufficient free board, side slopes, proper manning coefficient

** NB: The same approach can be used for drainage canals QAQC

9.5 IRRIGATION SYSTEM LAYOUT

No	Description	Project Doc	TOR, Guideline BM
	System Layout		
1	Main Canal		ASMP contour, visible & clear, heavy line weight
2	Cut of drain/ interception drain		Along the main canal & as required, different line weight/ type
3	Secondary Canals		Yes/No/ adequacy
4	Tertiary Canals		Yes/No/ adequacy
5	Field Canals		Yes/No/ adequacy
6	Furrow direction		ASMP furrow direction, not longer than 50m
7	Secondary Drain		Yes/No/ adequacy
8	Tertiary Drain		Yes/No/ adequacy
9	Field Drain		Yes/No/ adequacy
10	Farm roads		Yes/No/ adequacy
11	Division Boxes		Clear & Specific Node
12	Turnout		Clear & Specific Node
13	Offtakes		Clear & Specific Node
14	Road crossings/ Culverts		Clear & Specific Node
15	Night Storage location		
16	Aqueduct		Yes/No/ adequacy
17	Standard Nomenclature		For all canals & structures, legend

9.6 NIGHT STORAGE

No	Review Topic	Existing Document	Review Result/Comment (Against accepted guidelines)
	Night Storage/Reservoir		
1	Shape		
2	Capacity determination analysis		Demand, supply, available Q for storage,
3	Excavation volume		Capacity, free board, dead storage
4	Fill material and volume		Capacity, free board, dead storage, seepage,
5	Free Board		How it is determined
6	Slope (u/s & D/S)		Based on soil, depth and stability
7	Phreatic design		
8	Embankment		Height- Width relationship
9	Treatments considered (Lining / geo membrane)		
10	Inlet outlet design		Demand, supply, available Q for storage, material
11	Overflow / spillway design		
12	Dead storage		Silt, amount
13	Spillway		Position, capacity
14	Safety design/ Fence		

9.7 IRRIGATION PUMP DESIGN

No	Review Topic	Existing Document	Review Result/Comment (Against accepted guidelines)
	Pump		
1	General description of site investigation		
2	Source of Water (spring, river, ground water, lake)		
3	Topography, Geology & nature of foundation condition for pump seat		
	Data collection & methods		
4	Water sources/or river bed level		
5	Suction pool location (in case of separate point from the water source)		
6	Pump house design & BOQ		
7	Suction pool minimum water surface level		
8	Proposed pump set level		
9	Suction side profile data		
	Delivery line profile data		
10	Design		
11	Design duty (l/s/ha)		
12	Pump operating hour		
13	$NPSH_A$		
14	Suction hose Ø		
15	Suction side total Head		Friction head, fittings Losses, delivery head
16	Delivery head		

No	Review Topic	Existing Document	Review Result/Comment (Against accepted guidelines)
17	Deliver side Total head		Friction head, fittings Losses, delivery head
18	Delivery pipe Ø		
	Water hammering		
	Power requirement		
	Full Stability analysis when required		
19	Pump technical specification		
	Pump data		
20	Pump capacity		
21	Total static head		
22	Total dynamic head		
23	NPSH ($NPSH_R$ & $NPSH_A$)		
24	De rating		
25	Pipe material and installation		(GRP, GI, HDPE, etc.) and length, m, PN, fitting, bed & cover materials
26	Hydraulic/or pump set performance		
27	Pump part & component		
28	Material specification (casing, impeller, wear plate, shaft)		
29	mechanical seal bearing (ball & flap, mechanical seal, pump end bearing, pump drive end bearing)		
30	Pump priming methods (self-priming or air compressor/ Dri-prime system)		
	Pump/or motor power source data		
31	Total power requirement		
32	Fitting & dimensions		
33	Order for dimension & weight		
	Operational manuals		
34	Operational hour		
35	Operation & maintenance		
36	Pump economics		

9.8 SPECIFICATION AND BOQ

No	Review Topic	Existing Document	Review Result/Comment (Against accepted guidelines)
1.	Take of sheet		
2.	Head work excavation quantity and type		(soil, soft rock hard rock)
3.	Head work materials and quantity		(lean concrete, RCC, masonry, plastering, back fill)
4.	Gates (intake, under sluice – No, type, thickness, size, frame, etc.)		No, material, type
5.	Main Canal excavation material (soft & hard rock)		Length, sound volume, cart away
6.	Main Canal construction (shaping, retaining wall, lined canal, slab, plastering)		Length, foundation volume, two side volume, plastering
7.	Aqueduct / Flume (excavation, retaining wall,		Excavation volume by type,

No	Review Topic	Existing Document	Review Result/Comment (Against accepted guidelines)
	lined canal, slab, plastering, column RCC, slab RCC, etc)		masonry, RCC, formwork, No, plastering
8	Crossing structures (excavation, retaining wall, lined canal, slab, plastering, column RCC, slab RCC, etc)		Excavation volume by type, masonry, RCC, formwork, No, plastering
9	Control structures (Drop, offtakes, Division Boxes) - (excavation, retaining wall, lined canal, slab, plastering, column RCC, slab RCC, etc)		No, Excavation volume by type, masonry, RCC, formwork, No, plastering
10	Multi use structures (Cattle trough, washing basin) - (excavation, retaining wall, lined canal, slab, plastering, column RCC, slab RCC, etc)		Nos, Excavation volume by type, masonry, RCC, formwork, No, plastering
11	Night storage –(Excavation, Fill & compaction, shaping, intake and out let gates, cart away)		Volume of excavation by type, cart away, fill + compaction, gates, spill way structure volumes
12	Camping (standard drawing and quantity)		

Note: Consider working space for quantity calculation

9.9 DRAWINGS

	Review Topic	Existing Document	Review Result/Comment (Against accepted guidelines)
1	Headwork Topo – with Legend		1:500 scale, clear, weir location, BMs
2	Project system layout		1:500 scale, clear, weir location, BMs, all features, Nomenclature
3	Longitude and River cross section		1:100 V, 1:1000 H scale profile
4	Headwork plan, sections, gate details, Hatchings, dimensions, line types (hidden), - detail shape of earthen canal, lined canal, location of structures etc.		Different line weight, color and type, standard hatching
5	Main Canal profile, OGL. Design bed, Water level, Embankment level, Earthen canal excavation material (soft & hard rock)		Different line weight, color and type, standard hatching, canal cross section at different chainage
6	Structure drawings – (Aqueduct, standard drop with table, off take with table, drop box with table, crossings with table, MU structures) – plan with sections and detail		Plan, enough sections and details, standard hatching

9.10 UNIT COST ANALYSIS

No	Description	Existing Document	Review Result/Comment (Against accepted guidelines)
1	Detail material cost		
2	Detail skilled/unskilled cost		
3	Output/ rate		
4	Detail equipment cost		
5	Equipment outputs		
6	Direct cost		
7	Overhead cost		

9.11 ESTIMATED INVESTMENT COSTS & FINANCIAL FEASIBILITY

	Review Topic	Existing Document	Review Result/Comment (Against accepted guidelines)
1	Mobilization and camping		
2	Head works		
3	Main distribution system		
4	Secondary distribution		
5	Drainage system		
6	Access road		
7	Other infrastructure		
	Sub-Total		
8	Contingency (10-15%)		
9	Total Investment Cost		
10	VAT (15%)		
11	Total Cost With VAT		
12	Size of designed ICA (ha)		
13	Supervision and administration cost (5%)		
14	Investment cost per ha ICA		
15	Annual Running Costs		
16	Land preparation Farming means (oxen or machinery) (Br)		
17	Input costs (for each crop) (Br)		
17.1	Seed		
17.2	Fertilizers		
17.3	Labour		
17.4	Cultural practice (seeding, weeding, cultivating & harvesting)		
18	O&M cost (2-3% of the initial investment cost)		
19	Overhead costs (Br)		
19.1	Water charge		
19.2	Land tax		
20	Sub-total Annual Running costs		
21	Contingency for O&M (10%)		
22	Total ARC		
23	Total Costs (Investment + ARC)		
	Annual Production & Sales Revenue		
24	Total Production (for each crop) (qt)		

	Review Topic	Existing Document	Review Result/Comment (Against accepted guidelines)
25	Production disposal (for each crop) (qt)		
25.1	Home consumption		
25.2	For market		
25.3	Reserve for seed		
26	Sales Revenue		
26.1	Unit farm gate price for each product (Br/qt)		
26.2	Total Sales revenue projection (Br)		
27	Net Revenue (Total revenue – Total Costs) (Br)		
28	Net cash flow over the project years		
29	Calculated cost/benefit ratio (B/C or BCR)		
30	Calculated Internal rate of return (IRR %)		
31	Calculated Net present value (NPV %)		
31.1	Discount rate used is 10%		
31.2	Project life 20 years		

10 CERTIFICATION

The QAQC requires quality level certification. After auditing all the inputs, process, analysis, interpretation, and communication documents, the QAQC team will certify the level of the flaw impact on the project implementation. The following guiding points are indispensable in certification:

Under this title identify and summarize the defects in their impact level:

- High when the flaws can cause significant cost variation from the engineering estimate, delay or significant time extension and significant technology change.
- Medium, when the cost variation is under allowable and when the time extension and technology change are in acceptable limit.
- Low, When the defect doesn't affect the quality of the project and when there is no cost implication.

SSIGL 34

Prepared by

SMIS